Self Driving Cars

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PROBLEM STATEMENT

Design and develop a self-driving car system that can safely and efficiently navigate through various traffic scenarios, including intersections, lane changes, and pedestrian crossings, while obeying traffic laws and avoiding collisions. The ultimate goal of the project is to create a self-driving car that can reduce accidents and make transportation safer and more efficient for everyone.

Societal Benefits

1 Improved road safety

Self-driving cars can eliminate human error, which is a major cause of road accidents. As a result, self-driving cars could significantly reduce the number of accidents on the road, which would lead to fewer injuries, deaths, and property damage.

2 Increased mobility

Self-driving cars could help to increase mobility for people who are unable to drive, such as the elderly, disabled, or people who cannot afford a car. This would enable people to travel more easily and access jobs, education, and healthcare services.

3 Reduced traffic congestion

Self-driving cars can help reduce traffic congestion by optimizing traffic flow and reducing the number of accidents on the road. This would help to reduce travel times and improve the overall efficiency of the transportation system.

Societal Benefits

4

Lower emissions

Self-driving cars can be programmed to drive in a more fuel-efficient manner, which would help to reduce greenhouse gas emissions and improve air quality.

5

Improved productivity

Self-driving cars can enable people to work, study, or relax while commuting, which would increase productivity and reduce stress.

Literature Survey

- **2016** — End-to-End Learning for Self Driving Cars
- **2018** — A Survey of Autonomous Vehicle Technologies, Applications, and Social Impacts
- **2018** — Probabilistic Collision Detection for Autonomous Driving using Gaussian Process Dynamics and a Dynamic Occupancy Grid
- **2020** — Designing Safe and Explainable Autonomous Vehicles
- **2021** — Perception for Autonomous Driving: A Survey

Paper Name	Author and Year	Inference
End-to-End Learning for Self Driving Cars	Mariusz Bojarski (2016)	This paper proposes an end-to-end deep learning approach for self-driving cars that directly maps raw sensor inputs to steering commands. The authors demonstrate that their model can learn to drive on a wide range of roads and conditions, without the need for explicit feature extraction or sensor fusion.
A Survey of Autonomous Vehicle Technologies, Applications, and Social Impacts	Feng Yu and Joann S. Kowalski (2018)	This paper provides a comprehensive survey of autonomous vehicle technologies, applications, and social impacts, including regulatory, legal, ethical, and economic considerations. The authors analyze the potential benefits and challenges of self-driving cars, as well as their implications for urban planning, transportation policy, and human behavior.
Probabilistic Collision Detection for Autonomous Driving using Gaussian Process Dynamics and a Dynamic Occupancy Grid	Alexander Katrutsa (2018)	This paper proposes a probabilistic collision detection approach for self-driving cars that combines Gaussian process dynamics with a dynamic occupancy grid. The authors demonstrate that their method can improve collision avoidance performance compared to traditional occupancy grid-based methods, especially in complex and dynamic environments.
Designing Safe and Explainable Autonomous Vehicles	Tim Miller (2020)	This paper proposes a framework for designing safe and explainable autonomous vehicles that integrates formal verification, uncertainty quantification, and explainability methods. The authors demonstrate that their approach can improve the safety and reliability of self-driving cars, while also increasing user trust and transparency.
Perception for Autonomous Driving: A Survey	Ming Liang (2021)	This paper provides a comprehensive survey of perception technologies for autonomous driving, including sensor fusion, object detection and tracking, and semantic segmentation. The authors analyze the advantages and limitations of different perception methods, as well as their potential applications in self- driving cars.

Limitations

Limited Environmental Perception

Difficulty in handling complex situations

Limited understanding of social cues

Limitations

Cybersecurity risks

Legal and regulatory challenges

Limitations

Limited Environmental Perception

While self-driving cars are designed to handle a variety of driving situations, they can still struggle with complex scenarios such as merging onto a crowded highway, navigating a construction zone, or reacting to unexpected events like a pedestrian suddenly crossing the road.

Difficulty in handling complex situations

Self-driving cars rely on sensors such as cameras, radar, and lidar to perceive their surroundings. However, these sensors can be limited by poor visibility due to weather conditions such as heavy rain, snow, or fog. Additionally, they may not be able to detect certain objects such as potholes, road debris, or animals.

Limited understanding of social cues

Human drivers often rely on non-verbal communication and social cues to interact with other drivers and pedestrians. Self-driving cars have limited ability to understand these social cues, which can lead to unpredictable behaviour and accidents.

Cybersecurity risks

Self-driving cars rely heavily on software and connectivity, which can make them vulnerable to cyber-attacks. Hackers could potentially take control of a self-driving car's systems, leading to dangerous or even deadly situations.

Legal and regulatory challenges

Self-driving cars are subject to a complex web of laws and regulations that vary by state and country. Current regulations may not fully address the unique challenges presented by self-driving cars, which can make it difficult for manufacturers to develop and deploy these vehicles at scale.

Objectives

01

SAFETY

Self-driving cars can optimise their routes to avoid traffic and choose the fastest, most efficient path to their destination. This can help reduce travel times and congestion on the roads.

02

EFFICIENCY

The primary objective of a self-driving car is to improve safety on the roads by reducing accidents caused by human error. Self-driving cars can constantly monitor their surroundings and make split-second decisions to avoid collisions, even in complex traffic situations.

03

ACCESSIBILITY

Self-driving cars can make transportation more accessible to people who are unable to drive due to age, disability, or other factors. This can help improve mobility for a wide range of individuals.

04

ENVIRONMENTAL IMPACT

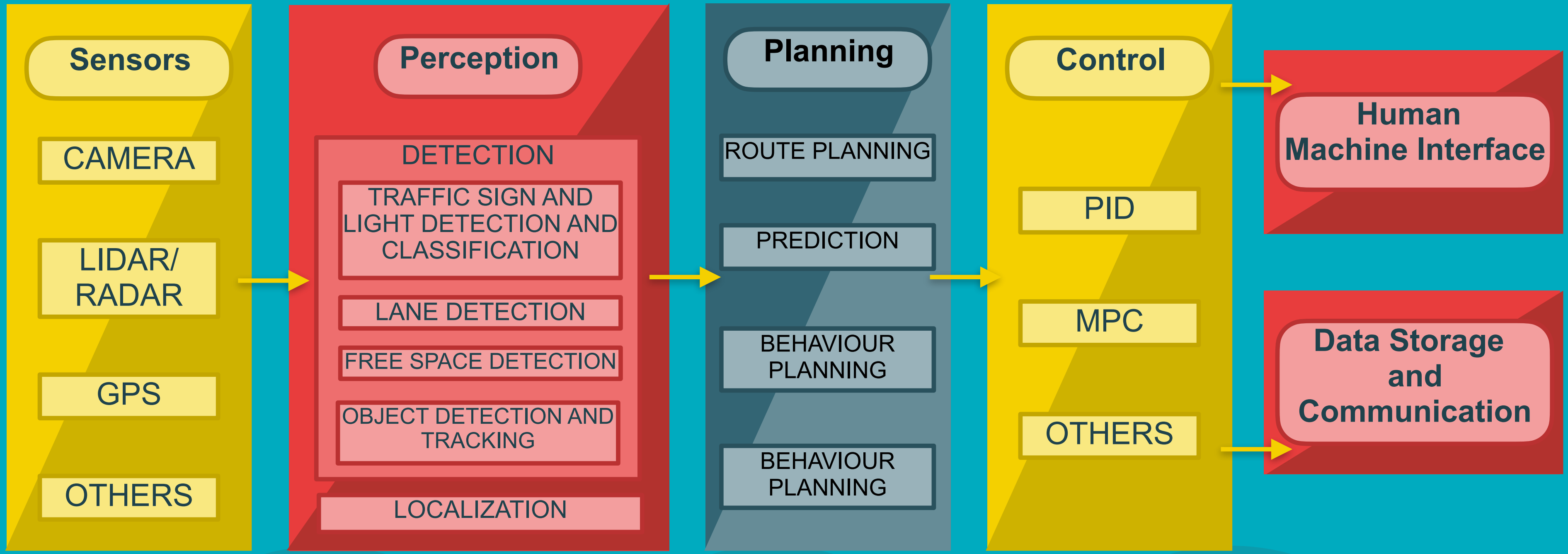
Self-driving cars can be programmed to drive in a more eco-friendly manner, such as by accelerating and braking more smoothly and avoiding idling.

05

COST SAVINGS

Self-driving cars can potentially reduce the cost of transportation by eliminating the need for a human driver, reducing fuel consumption, and improving the lifespan of the vehicle.

Architectural Diagram



Modules

Sensors

Self-driving cars are equipped with a variety of sensors that allow them to perceive the environment around them. These include cameras, lidar sensors, radar sensors, and ultrasonic sensors.

Perception module

The perception module processes the data from the sensors to build a detailed 3D map of the car's surroundings. This module uses computer vision and machine learning algorithms to identify objects such as other cars, pedestrians, road signs, and traffic signals.

Planning and decision-making module

This module takes the data from the perception module and uses it to make decisions about how the car should move. It plans a safe and efficient route to the car's destination, taking into account factors such as traffic, road conditions, and weather.

Modules

Control module

The control module is responsible for controlling the car's movements. It receives instructions from the planning and decision-making module and uses actuators such as the steering, throttle, and brakes to execute those instructions.

Human-machine Interface

The human-machine interface (HMI) provides a way for the car's passengers to interact with the car. This may include a touchscreen display or voice commands that allow the passengers to input a destination or make other requests.

Data storage and communication

Self-driving cars generate vast amounts of data, including sensor data, map data, and other information. This data needs to be stored and communicated between different components of the car and potentially with external systems such as traffic management centers.

Thank you